

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 639394/c	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).	
International Application No. PCT/AU2003/001088	International Filing Date (day/month/year) 27 August 2003	Priority Date (day/month/year) 5 November 2002
International Patent Classification (IPC) or national classification and IPC Int. Cl. ⁷ C02F 1/52, 1/58, 1/14		
Applicant GEO-PROCESSORS PTY LIMITED et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
- ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 7 sheet(s).

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 5 May 2004	Date of completion of the report 22 February 2005
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer ADRIAN GILLMORE Telephone No. (02) 6283 2125

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/AU2003/001088

I. Basis of the report**1. With regard to the elements of the international application:***

- ☐ the international application as originally filed.
- ☒ the description, pages 1-75, as originally filed,
pages , filed with the demand,
pages , received on with the letter of
- ☒ the claims, pages , as originally filed,
pages , as amended (together with any statement) under Article 19,
pages , filed with the demand,
pages 76-82, received on 16 February 2005 with the letter of the same
- ☒ the drawings, pages 1/23-23/23, as originally filed,
pages , filed with the demand,
pages , received on with the letter of
- ☐ the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , received on with the letter of

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/fig.

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/AU2003/001088

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims 1-36	YES
	Claims	NO
Inventive step (IS)	Claims 1-36	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-36	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

D1: US 4423009

D2: AU 677563

D3: US 4956157

D4: DE 39133044

D1-D4 each disclose treating water with a calcium source in order to form a precipitate and a treated liquid and separating them.

The applicant argues that the citations do not relate to the treatment of water as defined in Table 1 of claims 1 and 7 and further that a product of precipitated calcium carbonate or gypsum-magnesium hydroxide is not produced by any of the citations. Therefore claims 1-36 are novel and inventive over D1-D4.

All claims are industrially applicable.

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CLAIMS

1. A method of treatment of water containing dissolved solids, wherein the water is selected from the group consisting of types 1 to 7 waters as defined in Table 1:

TABLE 1

Type	TDS (g/L)	Cl/HCO ₃ ⁻ mol.	Cl/2SO ₄ ²⁻ mol.
1	1 to 60	<2	>1
2	1 to 15	≥2	>1
3	1 to 15	>2	<1
4	> 15, ≤60	>5	>7
5	> 15, ≤60	>5	<7
6	>60	>5	>9
7	>60	>5	<9

comprising the steps of:

- (a) contacting the said water with a first reagent comprising a source of calcium ions selected from the group consisting of calcium oxide, calcium hydroxide, and a combination thereof, so as to cause at least some solids dissolved in the water to react with the first reagent and to form a first solid product and a partially processed water wherein, in the event that the water containing dissolved solids is a Type 1 water, the first solid product is precipitated calcium carbonate (PCC) and, in the event that the water containing dissolved solids is a water of any of Types 2 to 7, the first solid product is gypsum-magnesium hydroxide mixture (GMH) and wherein the said GMH is further treated by the addition of sulphuric acid to react with 5-50% of the stoichiometric amount of magnesium hydroxide present in the GMH;
- (b) recovering the first solid product from the partially processed water;

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- (c) at least partially concentrating the partially processed water or a portion thereof, so as to promote the formation of a precipitate and a mother liquor, and
- (d) recovering the precipitate from the mother liquor as a second product.
- 5 2. A process as claimed in claim 1, wherein the water is a type 1 water having a salinity of from 1 to 50 g/L TDS.
3. A process as claimed in claim 1, wherein the water is a type 1 water having a salinity of from 1 to 40 g/L TDS.
4. A process as claimed in claim 1, wherein the water is a type 1 water having a salinity of from 1 to 30 g/L TDS.
- 10 5. A process as claimed in claim 1, wherein the water is contacted with a predetermined amount of the first reagent.
6. A process as claimed in claim 1, wherein the water is a water of type 1 and the first product is precipitated calcium carbonate (PCC).
- 15 7. A process as claimed in claim 1, wherein the water is a water of type 1 and the second product is sodium hydroxide.
8. A process as claimed in claim 1, wherein the water is a water of any one of types 2, 4, 5, 6 and 7, and the second product is sodium chloride.
9. A process as claimed in claim 1, wherein the water is a water of type 3, and the second product is sodium sulphate.
- 20 10. A process as claimed in claim 8, wherein, after step (b), the partially processed water is contacted, in a step (e), with a second reagent also comprising a source of calcium ions selected from the group consisting of calcium oxide, calcium hydroxide, and a combination thereof, so as to cause at least some of the solids dissolved in the partially processed water to react with the second reagent and to form magnesium hydroxide, and wherein the magnesium hydroxide is recovered from the partially processed water before the recovery of said sodium chloride therefrom.
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11. A process as claimed in claim 1, wherein the water is a water of type 1 and the pH of the partially processed water is reduced, in a step (b)(i), to a pH falling within the range of from 7 to 10.
12. A process as claimed in claim 11, wherein the pH of the partially processed water is reduced by adding to the partially processed water a pH reducing agent selected from the group consisting of hydrochloric acid, sulphuric acid, saline impaired feed water, an RO concentrate of type 1 water, and a combination of any two or more thereof.
13. A process as claimed in claim 11, wherein the water is a type 1 water, the pH of the partially processed water is reduced to between 8 and 9 by adding sulphuric acid to the partially processed water and wherein the second product is sodium sulphate.
14. A process as claimed in claim 11, wherein the water is a type 1 water, the pH of the partially processed water is reduced to between 8 and 9 by adding hydrochloric acid to the partially processed water and wherein the second product is sodium chloride.
15. A process as claimed in claim 11, wherein the water is a type 1 water, the pH of the partially processed water is reduced to between 8 and 9 by adding diverted water to the partially processed water and wherein the second product is sodium carbonate.
16. A process as claimed in claim 6, wherein the first reagent is hydrated lime slurry and the weighted average sulphate ion concentration of the water and the hydrated lime slurry is controlled below 3 g/L.
17. A process as claimed in claim 16, wherein the weighted average sulphate ion concentration is controlled by controlling the volume of hydrated lime slurry contacted with the water or by controlling the concentration of solids in the hydrated lime slurry, or by both.
18. A process as claimed in claim 1, wherein the reacted GMH product is dried at a temperature between 120°C and 300°C.

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19. A process as claimed in claim 1, wherein the water to the process is a type 4 or a type 6 water, wherein, after step (b), sodium carbonate is added to the partially processed water, and wherein magnesium carbonate light (MCL) is recovered therefrom to produce a treated water which is low in magnesium content.
20. Use of the treated water produced by the process of claim 19 in a cyanide based leach process.
21. A process as claimed in claim 6, wherein, in step (a), only a portion of the bicarbonate ions in the water are converted to PCC and, wherein, in a secondary reaction step, the first solid product and the partially processed water of step (a) are contacted with a solution of calcium chloride to convert substantially all of the carbonate ions in the partially processed water to PCC.
22. A process as claimed in claim 6, wherein, in step (a), only a portion of the bicarbonate ions in the water are converted to PCC and, wherein, in a secondary reaction step after the recovery of the said PCC in step (b), the partially processed water of step (b) is contacted with a solution of calcium chloride to convert substantially all of the remainder of the carbonate ions in the partially processed water to supplementary PCC.
23. Use of magnesium hydroxide recovered from the process as claimed in claims 10 or 17 to pre-condition water to an RO desalination plant.
24. A process as claimed in claim 1, wherein the water is or comprises a concentrate from an RO desalination plant.
25. A process as claimed in claim 1, wherein a portion of the mother liquor of step (d) is combined with the partially processed water from step (b) before it is subjected to evaporation in step (c).
26. A process as claimed in claim 1 or claim 25, wherein a portion of the mother liquor of step (d) is evaporated to total dryness.
27. An apparatus for the treatment of water containing dissolved solids, wherein the water is selected from the group consisting of types 1 to 7 waters, as defined in Table 1:

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TABLE 1

Type	TDS (g/L)	Cl/HCO ₃ ⁻ mol.	Cl/2SO ₄ ²⁻ mol.
1	1 to 60	<2	>1
2	1 to 15	≥2	>1
3	1 to 15	>2	<1
4	>15, ≤60	>5	>7
5	>15, ≤60	>5	<7
6	>60	>5	>9
7	>60	>5	<9

comprising:

- (A) means for contacting the said water with a first reagent comprising a source of calcium ions selected from the group consisting of calcium oxide, calcium hydroxide, and a combination thereof, so as to cause at least some of the dissolved solids to react with the first reagent and to form a first solid product and a partially processed water; wherein, in the event that the water containing dissolved solids is a Type 1 water, the first solid product is precipitated calcium carbonate (PCC) and, in the event that the water containing dissolved solids is a water of any of Types 2 to 7, the first solid product is gypsum-magnesium hydroxide mixture (GMH) and wherein the GMH is further treated by the addition of sulphuric acid to react with 5-50% of the stoichiometric amount of magnesium hydroxide present in the GMH;
- (B) means for recovering the first solid product from the partially processed water;
- (C) means for at least partially concentrating at least a portion of the partially processed water, so as to promote the formation of a precipitate and a mother liquor; and

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(D) means for recovering the precipitate from the mother liquor as a second product.

28. An apparatus as claimed in claim 27, wherein the means (A) comprises a train of up to three mixed reactors.
- 5 29. An apparatus as claimed in claim 27, also comprising a washing unit selected from a counter current washing unit and a co-current washing unit, for washing the first product after recovery thereof.
30. An apparatus as claimed in claim 27, also comprising an RO desalination plant, and wherein the desalination plant produces a permeate which has a low
10 concentration of dissolved solids and a concentrate which has a high concentration of dissolved solids, and wherein the concentrate is fed to the means (A).
31. An apparatus as claimed in claim 27, also comprising a break tank for stripping dissolved methane gas from the feed water.
- 15 32. An apparatus as claimed in claim 27, also comprising a lime slaker for preparing lime slurry for use in the means (A).
33. An apparatus as claimed in claim 27, wherein the means for at least partially concentrating is an enhanced solar evaporation system, comprising:
20 -means for pre-concentrating the dissolved substance by evaporating a portion of the water from the solution so as to form a concentrated solution;
-a container for holding the concentrated solution and for absorbing solar energy so as to cause the temperature of the concentrated solution to rise; and
-evaporation means for causing water to evaporate from the concentrated
25 solution..
34. An apparatus as claimed in claim 33, also comprising a crystalliser for causing the dissolved substance to precipitate from the concentrated solution after water has been evaporated from the concentrated solution in the evaporation means.

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35. A process for treating a saline process water in a gold mining operation comprising the steps of adding a lime slurry [$\text{Ca}(\text{OH})_2$] first under fast and then under slow mixing conditions to form a slurry, which slurry is then washed and dewatered to produce a compound of desired thickness, comprised of $\text{Mg}(\text{OH})_2$ and CaCO_3 minerals, and storing and aging the spent water to mature by aeration, which solution can then be fed directly to a CIL circuit.
36. A process for the manufacture of PCC compounds from mildly saline waters of surface or ground water origin, comprising:
- (a) if required, pre-concentration of the raw ground water solution by natural evaporation or artificial means, to adjust bicarbonate (HCO_3) ion concentration in the solution to between 1g/L and 15g/L HCO_3 ;
 - (b) reaction of the said raw ground water or pretreated feed solution with hydrated lime slurry, under constant stirring conditions, at temperatures 30°C or higher, to allow formation of a slurry due to nucleation of fine grain calcium carbonate crystals;
 - (c) transfer of the slurry to a solids/liquid separation vessel to allow proportional removal of the decarbonated supernatant (spent water) to a neutralisation vessel, followed by pH adjustment to around pH 7 by adding acid, and re-use or disposal of the resultant neutralised water;
 - (d) transfer of the slurry to a wash thickener vessel, washing the slurry first with fresh water to remove excess dissolved salts, followed by thickening to obtain a precipitated calcium carbonate slurry product;
 - (e) optionally and depending on market requirements, further dewatering of the precipitated calcium carbonate slurry product (in "d") to obtain a cake, which is dried and powdered to obtain a precipitated calcium carbonate powder product.

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